TELEVISION EQUIPMENT

--A REPORT BY THE ENGINEERING COMMITTEE OF THE NATIONAL ASSOCIATION OF EDUCATIONAL BROADCASTERS

MAY 4, 1953

FOREWORD

In order to evaluate the latest television equipment available for use of educational television stations and program production centers, the N.A.E.B. Engineering Committee met in Los Angeles in early May to study equipment that was on display at the N.A.R.T.B. Equipment Exhibition. Members of the Committee secured technical data, watched equipment performance, and evaluated available information and equipment for guidance of institutions and persons concerned with technical television equipment.

The equipment evaluation in the Report is concurred in by all members of the Committee. Additional helpful information is contained in Section II, a summary of technical papers presented at the N.A.R.T.B. Convention, held in Los Angeles.

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NAEB ENGINEERING COMMITTEE REPORT
May 4, 1953

This report covers television and radio broadcasting equipment displayed at the NARTB convention in Los Angeles, April - May 1953. Emphasis is placed on the description of new equipment shown or announced for the first time. Of particular interest were the flying spot continuous motion film chains, television recorders and the use of cameras incorporating photoconductive type tubes. These are described below. An attempt is made to give as much information as possible for those educational institutions which plan to purchase television equipment. However, prices are not quoted. In some instances manufacturers allow educational discounts, others will supply engineering supervision at no cost and others will ship FOB destination. Also, where equipment may be purchased on a bid basis, prices may vary from those quoted. It is therefore suggested that prospective purchasers contact manufacturers direct for definite price information.

Either with this report or in the near future you will receive a packet of literature published by various manufacturers and covering details of equipment which would be impossible to present in the report. This packet will contain not only detailed equipment specifications but will also have several publications of an engineering nature covering subjects important in station planning. Examples are studio lighting, antenna design and calculations, station planning, etc.

The NAEB Engineering Committee had outlined, as one of its first projects, a rather complete guide to educational television planning, design, procedure, etc. Such a report has recently been prepared, after considerable effort, by Mr. Arthur Hungerford of JCET. It was thought that any such work by this committee would be a duplication of effort. Inasmuch as Mr. Hungerford has done such an excellent job the Committee has asked him to pass on the information to NAEB members. Therefore, either with this report or within a short time, you will receive a copy of the JCET publication.

In the report which follows, the Committee has made an attempt to describe new television equipment and, in pertinent cases, to present some form of evaluation. Obviously such an evaluation may be subject to change in the case of equipment which has not been in actual use under field conditions for some time. The Committee has made every effort to be fair in its evaluation but the condition noted must be recognized. Also, developments are being made so rapidly and new equipment is undergoing laboratory test that the picture may change. This, however, should not deter those interested from proceeding with television plans as this situation is apt to be true for many years.

TELEVISION TRANSMITTERS

Television transmitter equipment was displayed at the NARTB conference by five manufacturers and included four VHF and five different UHF types.

The VHF types included complete 5, 10 and 25 kilowatt transmitters and a 20 kilowatt amplifier for use in increasing power at stations currently equipped for 5 kilowatt operation. These transmitters feature air cooled vacuum tubes throughout, the air cooled radiator fin type of tube being used. The transmitters shown gave every indication that considerable improvement has been achieved in VHF transmitters reflecting the intense development in such equipment since the beginning of commercial television. Tetrode amplifiers were universally used in the final amplifier stages, usually with grid modulation. Elaborate power control circuits now provide desirable operating conveniences that will insure reliable trouble free operation and quick location of trouble when it occurs. The reduction in cost of vacuum tubes used in VHF transmitters, not yet achieved for UHF, also reflects the successful development work of the past few years that will result in more economical operation.

The Gates Radio Company of Quincy, Illinois, displayed a 500 watt VHF transmitter of unusually compact design. Constructed in three steel cabinets, this transmitter uses two type 4-400A tetrode vacuum tubes in the final amplifier and was grid modulated. Good power control circuits were provided to give good operating convenience. The appearance and workmanship appeared to be excellent in every respect. The power input was reported to be 3 kilowatts for full power operation. This manufacturer also lists a 5 kilowatt VHF transmitter.

The Allen B. Dumont Laboratories of Clifton, N. J., showed a 25 kilowatt transmitter. It was constructed in seven large cabinets and appeared to be well built in every respect. The final amplifier used one water cooled type 4W20,000A vacuum tube operating as a linear amplifier following low level grid modulation. This transmitter required a power input of 66 kilowatts for full power operation. All equipment except the plate power transformer and heat exchanger were mounted within the transmitter cabinets. Output power is delivered through two 3 1/8 inch coaxial transmission lines. An external sideband filter is not required. This company also manufactures VHF transmitters of 500 watts, 5 kilowatts and 50 kilowatts output power.

The Radio Corporation of America displayed a new 10 kilowatt VHF transmitter, type TT10AL/AH. Mounted in six cabinets, this transmitter occupies about one half the floor area of earlier 5 kilowatt transmitters, is completely air cooled and is entirely contained in the cabinents except for the external mounted plate supply power transformers. One type 6166 air cooled tetrode vacuum tube is used in the final grid modulated amplifier. Single ended amplifiers and fewer r.f. stages are reported to result in more economical operation and lower tube costs. The design requires but one broadband circuit, reducing tuning difficulties. Power input for full rated output with black picture is reported to be 42 kilowatts. Output power is delivered through two 3 1/8" coaxial lines and requires an external vestigal side band filter and diplexer. Adequate power control circuits provide desirable operating convenience. The operating characteristics are reported to be better than present standards and adequate for color operation. This manufacturer also lists 500 watt, 2 kilowatt, 20 kilowatt and 50 kilowatt VHF television transmitters.

The Standard Electronics Corporation of Newark, N. J., exhibited a 20 kilowatt VHF amplifier for use with a 5 kilowatt transmitter where it is desired to increase power. This is a complete unit contained in two large cabinets, including plate transformers. The power input for full rated output is 50 kva. Four type 4-AX9904R Amperex air cooled vacuum tubes are used in this amplifier which operates linearly. The construction provides better than usual accessibility and features full length glass doors with all vacuum tubes visible during operation. Output power is delivered through two 3 1/8 inch coaxial lines and a small vestigal side band filter is mounted in the transmitter cabinet. The single ended coaxial circuits used are reported to provide exceptional freedom from spurious oscillations and parasitics. This manufacturer also makes 500 watt, 5, 10 and 50 kilowatt VHF television transmitters.

The five UHF transmitters displayed illustrate the intense development work that has taken place during the past year. While many uncertainties still exist in this type of equipment, the indications clearly point to substantial progress in development, design and production. Two models exhibited were reported to be ready for delivery to west coast stations following the exhibit. It was clearly evident that a tremendous advance has been achieved in UHF transmitters during the past year through intensive development which will undoubtedly continue during the next few years. Many important engineering problems have found satisfactory solution and several of the transmitters exhibited have had sufficient field use to warrant the conclusion that they can be made to operate satisfactorily. Future progress will certainly include development of more high powered UHF transmitters and reduction of tube and operating costs. The development of UHF transmitters has been so rapid and recent that no accurate knowledge of tube life or operating costs is available today.

The General Electric Company, Electronics Division, of Syracuse, N. Y., exhibited 100 watt and 12 kilowatt UHF television transmitters. The 100 watt unit was connected and operating into an artificial antenna, the only transmitter that was exhibited in actual operation. This 100 watt transmitter is completely self contained in one cabinet and is air cooled. A single 4X 150A vacuum tube is used in the output stages and is grid modulated by a clamp type modulator. Approximately 3 kilowatts single phase input power is required to achieve full rated output. Excellent control circuits are provided and a sweep oscillator is incorporated to facilitate test and adjustment of the transmitter. An external side band filter and diplexer is required.

The 12 kilowatt transmitter exhibited by General Electric incorporated the above described 100 watt transmitter as a driver-exciter for linear klystron amplifiers for both aural and visual parts of the transmitter. The type GL6241 klystron is water cooled, approximately 51 kilowatts of heat being dissipated in the cooling water. A three phase power input of approximately 100 kilowatts is required for full rated power output. Five integrated steel cabinets contain all UHF circuits with plate transformers, filter reactors and water cooling equipment mounted externally in an interlocked enclosure. An external side band filter and diplexer is used with output power from two 3 1/8 inch coaxial lines.

The Radio Corporation of America, Camden, N. J., exhibited a one kilowatt UHF television transmitter, type TTU1B. Mounted in three cabinets, it employs

an air cooled type 6181 tetrode as final amplifier and is cathode modulated. All power supply components are air cooled and mounted within the cabinets. A single phase power input of 9.6 kilowatts is required for black picture and full rated output. A filterplexer is used external to the transmitter and combines the functions of a vestigal side band filter and diplexer. Radio frequency output is through two 3 1/8 inch coaxial lines. Characteristics somewhat better than F.C.C. requirements for monochrome transmission are reported by the manufacturer as being adequate for use with the proposed RTMA color standards. This transmitter is also used as a driver for a 10 kilowatt amplifier under development.

The Allen B. Dumont Laboratories of Clifton, N. J., display a one kilowatt UHF television transmitter which was not complete, the final amplifier not being in place. All other equipment was mounted in two cabinets and was reported to use all air cooled tubes and components. A General Electric type 6183 tetrode is to be used as the final amplifier in both visual and aural sections. Other information was not complete and apparently further development work was in progress.

The Standard Electronics Corporation of Newark, N. J., showed a one kilowatt UHF television transmitter of new design. It was self contained in two cabinets with full height glass windows that made all components visible under operating conditions. A single phase power input of 5.5 kilowatts is required for full rated output with black picture. Output radio frequency connections were through 1 5/8 inch coaxial lines. A General Electric type 6183 air cooled tetrode was used in the final amplifiers. This transmitter is planned as a driver for a 15 kilowatt amplifier which this manufacturer has under development.

The design and production of VHF television transmitters has now reached an advanced stage and many excellent dependable transmitters are now available that will prove to be satisfactory and economical in operation. UHF transmitter development is certain and will result in higher power output and more economical operation. Immediate operation is both possible and practical in UHF today.

The purchaser of a television transmitter must carefully determine operating costs to make an intelligent decision in the purchase of a transmitter. Operating costs are vacuum tube costs per hour plus the electrical energy needed to operate the transmitter and associated equipment. The above descriptions give the large tube types required for each transmitter from which the prospective purchaser may determine costs. The power input required for normal operation is also given so operation costs can be accurately determined for local conditions. A study of the available transmitters indicates a wide difference in power input requirements, hence it is important that this factor be carefully considered. Reliability and dependability are factors determined principally by the quality of components used and good engineering design not easily evaluated without wide experience and knowledge in this field.

TELEVISION CAMERAS

As far as equipment shown at the NARTB convention is concerned, television camera considerations may be placed under the following two headings:

Group 1 - Standard Image Orthicon camera chains
Example: RCA, GE, Dumont, GPL, Federal.

Group 2 - Contemporary pickup units based on photoconductive image tubes.
Example: Vidicon (RCA) (Dage), Staticon (GPL).

It should be indicated that an unidentified type of camera was exhibited by Standard Electronics Corporation and called a "Mystery Camera." Since it was impossible to obtain any specific information on its image tube it remains unclassified. This camera is intermediate in physical size when compared with Vidicon and image orthicon units and its mechanical features present some operating difficulty.

Group 1 - Standard Image Orthicon Studio and Field Camera Chains.

Radio Corporation of America - This manufacturer claims specific improvements in design over its previous models. Primary new features claimed were as follows:

(1) Portability - Improved carrying handles of tubular design on each side of camera unit for greater ease in transporting.

(2) Focus Control - A variable ratio linkage incorporated in the optical focus control in order to introduce a vernier adjustment when focusing within the critical ranges of image orthicon travel. Such change in mechanical ratio is automatic and a function of image orthicon position.

(3) Accessibility - Improved accessibility is claimed due to advanced mechanical design permitting complete "hinging out" of various sections of camera unit.

(4) Remote Iris Control (Optional) - This feature permits adjustment of the camera iris from the camera control and monitor position. Iris settings are indicated on a meter provided at the control position. Such indications are on an arbitrary numerical meter scale rather than "f" stop. (To this date GPL is the only other manufactuerer offering this feature.)

(5) Image Orthicon Focus - This adjustment is provided at both camera and control positions in order to expedite basic warm-up adjustments.

(6) Camera Viewfinder - A seven inch viewfinder tube has been added without any apparent increase in the camera size or sacrifice in internal structure. Visibility is considerably improved with the larger tube.

(7) Oversweep - An "oversweep" switch has been added permitting sweep width and height to be enlarged above normal during warmup and rehearsal. Such use minimizes the burning-in of the raster due to continued camera operation and extends useful image orthicon life. (Dumont, General Electric and GPL also have this feature.)

(8) Alignment - Mechanical image orthicon alignment has been supplanted by a completely electronic method. This procedure is accomplished by the use of two coils with quadrature currents of different magnitudes.

(9) Temperature Control - A thermostatic control has been incorporated in order to regulate internal camera temperature and stabilize image orthicon performance.

General Precision Laboratory - No noteworthy additional features are claimed over previous models. The primary appeal of this camera line is its optional remote control operation. This is done without any apparent sacrifice of camera quality when compared with other lines. Some of the interesting features of this camera unit are as follows:

(1) Complete hinged "lay-out" of camera interior with unit in operation.

(2) Remote Iris Control - This is a standard feature with GPL. Remote meter indicates in "f" stop settings at the camera control monitor unit.

(3) Focus Range Control - Permits extension of focus range down to two inches in order to give greater range of operation. This feature is unique to this make of camera.

(4) Oversweep - Included as a standard feature.

(5) Remote Control - A complete remote control is available for GPL cameras. Details are given below.

(6) Intercom Amplifier - An intercommunication amplifier is standard with the GPL camera in order to assist camera operation in high noise areas.

Where remote operation of camera equipment is mandatory or desirable, the GPL line stands alone in filling the need. Such operation has been packaged in a convenient form permitting the following control to be exercised:

(1) Remote Pan (280 degrees) and Tilt (63 degrees) - Various degrees of "stiffness" are provided in the servo control in order to accomodate the operator's need. A flip of a switch introduces "constant velocity" pan and tilt for smooth follow up of subject movement.

(2) Remote Focus - Servo controlled optical focus from remote position.

(3) Remote Lens Selection - Servo controlled lens selector from remote position.

(4) Remote Iris Control - Permits setting of iris at camera control position.

(5) Preset Combination - Remote control feature permits, in addition to manual control, the presetting of six distinct conditions of pan, tilt, focus and lens. These can be set up at the remote point by means of potentiometers affecting the various servo circuits. Accordingly, six completely different shots may be set up for one camera and selected by push buttons.

The selection cycle, which averages more than one second, is not sufficiently short to compare favorable with instantaneous "takes" possible with standard switchers. However, a combination of two remote controlled cameras permits a very flexible arrangement where required. The GPL camera line is manufactured in England according to GPL specifications. Tubes and most parts are standard. All parts as well as engineering services are available through GPL.

Federal - The Federal television line uses DuMont camera equipment exclusively. Details given regarding DuMont cameras apply to cameras sold by Federal.

General Electric - No new features are claimed in camera design other than the addition of a portable chain to their equipment line. GE previously secured their portable equipment through DuMont while concentrating on the development and marketing of studio cameras and accessories. The new portable chain seems to be unusually well built and compact. The oversweep switch is located at the camera position. Tubular carrying handles permit transporting cameras with greater ease. Though no other new features are claimed, the camera seemed high grade in every respect and gave excellent performance.

DuMont - Basic design and construction of DuMont cameras remain essentially the same as in previous models. The manufacturer claims continued emphasis on extremely high quality of picture obtainable with their equipment. One exclusive feature of the DuMont camera is the type of optical focus control used. This control is built into the auxiliary pan-handle extending from the camera unit. This feature gives the operator an opportunity to guide the camera's position with both hands and still have control over the optical focus.

The DuMont system still incorporates the use of an auxiliary unit between the camera and camera control unit. This they justify on the basis of its function in such instances where long cables are used between the camera and the control monitor as well as the removal of a number of tubes from the camera unit proper. DuMont equipment uses its own special type of camera cable which is not interchangeable with that of other manufacturers such as RCA, GE, GPL, etc.

Remote iris control is not available in the sense used in the RCA and GPL cameras. However, a mechanical linkage is provided as a

standard feature which permits the operator to adjust the lens iris from the rear of the camera.

An oversweep switch is provided at the auxiliary unit.

Group 2 - Contemporary Pickup Units Based on Photoconductive Image Tubes

While the average person acquainted with television is inclined to place the photoconductive type of camera pickup tube in the class of strictly industrial equipment, the various manufacturers tend to encourage broadcasters to give reasonable consideration to its use in the field of television broadcasting. A word of caution should be expressed in this line of thinking with respect to the present state of development of photoconductive camera tubes. On the basis of what was shown at the NARTB convention, they cannot be recommended as a completely satisfactory substitute for live camera work with "on the air" operation. This does not mean that further development will not result in improvements which might elevate this class of pickup unit into the class of the image orthicon camera. Demonstration of the Vidicon and Staticon tend to indicate that cameras of this class have real possibilities even at the present time, when used for film or still pickup work. As has been indicated elsewhere in this report, RCA, GPL and others demonstrated film pickup units based on the use of the photoconductive tube which had excellent operating characteristics. Operating light levels are the primary difference which permits such early application of this type of tube in the broadcast field. Colleges or other users who are interested in cameras for strictly closed circuit or rehearsal activity might well give serious consideration to the use of this class of equipment at the present time. Where operation might ultimately extend to "on the air" telecasting, such an investment presents a risk at the present state of development because of the following shortcomings:

(1) Lack of uniformity in production line manufacture of photoconductive pickup tubes. The yield of tubes having requisite definition, and other operating characteristics desirable for high quality pickup work is low at the present time.

(2) Light levels required for satisfactory operation of the best photoconductive tubes are in excess of those required for image orthicon pickup tubes. This would present a major problem in lighting for studio use.

Pickup units based on photoconductive type tubes were displayed by RCA, GPL and Dage Electronics Corporation. The RCA unit which was demonstrated primarily as a film pickup unit is described elsewhere in this report under the section on film facilities.

The Dage display was of considerable interest since this company offers a complete line of video camera equipment based on the photoconductive pickup tube. Dage has developed a matching set of units consisting of camera, control and monitor, sync generator, and switcher - each packaged in a fraction of the size of standard camera equipment. The standard package size of each of the indicated units is fourteen inches long by nine and three eighths inches high by four and five eighths inches wide. Weight of each unit is approximately twenty pounds. Both the camera and camera

control units contain a small picture monitor tube. Power consumption, basic cost of operation, and purchase price are very low as compared with that of standard image orthicon camera equipment. While the manufacturer makes no definite claims regarding line resolution, the chain seems to perform well considering the fact that a photoconductive tube is used. It is very likely that a limiting factor in picture quality lies in the camera tube itself and is subject to improvement as tube design improves.

As was indicated previously, purchase of this class of equipment should be approached with caution, especially where "on the air" work or professional activity is contemplated. However, where a camera facility is required for closed circuit or rehearsal activity, the Dage line presents many interesting possibilities since it offers a complete set of units based on a specific level of design criteria.

GPL also displayed a camera using a photoconductive type tube and named the Staticon. This camera is small in size, well constructed, and with the limits noted above, produced a picture comparable to other cameras of this type. It is designed to be integrated into the equipment plan of a standard television installation, using standard cable and connectors, and may be used as a direct camera replacement.

Lenses

Two new zoom lenses made their appearance at the NARTB convention. They are:

Studio Zoomar - Zoomar Corporation

GPL - Watson Vari-Focal - General Precision Laboratories.

The first of these, the Studio Zoomar, is especially designed for use in studio applications. As such, it is a single purpose unit intended to complement previous models of Zoomar lenses having greater focal length. Its physical dimensions are small considering its complexity - approximately twelve inches in length and eight inches maximum unit width. It derives its support from its attachment to the lens plate and its "zoom" control which passes through the core of the turret shaft. The maximum lens speed is rated at F 2.8.

The GPL- Watson Varifocal lens is designed as a dual purpose unit intended for outdoor as well as indoor use. A small change permits it to operate on one or another of its ranges. These two ranges permit a change in focal length of three inches to fifteen inches on one and six inches to thirty inches on the other. Areas are varied by a ratio of twenty-five to one in a complete zoom. The mounting detail of this camera is such that a special support is required. Its physical size is fourteen inches long by seven inches wide by eight and one-half inches high. Its optical and mechanical design seem to be excellent. The "f" rating of the lens at its fastest adjustment is 3. This lens is distributed by the General Precision Labs.

FILM CHAINS, PROJECTORS AND VIDEO RECORDERS

There were on display ten different film chains by eight different manufacturers at the NARTB convention. These were broken down into three distinct types, that is: (1) Iconoscope (2) Photo-multiplier (Flying Spot) (3) Photoconductive (Vidicon). The most widely shown type was the photoconductive type of picture pickup tube.

There were five companies demonstrating this type of film equipment in varying degrees of development. They were Dage Electronics, Vidicon; Federal Telecommunications, Photocon; General Precision Laboratories, Staticon; RCA, Vidicon; and Standard Electronics with a tube they refuse to describe but guessed by some to be the Phillips type tube.

The trend toward the use of these tubes seemed to be three-fold: (1) low replacement cost and long life (2) small sized and simplicity of operation (3) in some cases dual purpose for film pickup and/or live pickup in the studio or on remote location.

Dage Electronics used a Vidicon camera in conjunction with an RCA pulsed light projection shooting directly into the camera, with very good results. This entire setup took little more than six square feet of floor space including projector, camera, camera control, mixer and sync generator. Their system had no provision for the insertion of slides but required another camera and camera control unit to shoot live cards or projected cards. Their camera pickup unit was directly interchangeable with the RCA camera.

RCA demonstrated a Vidicon camera as a film pickup device with exceedingly good results because of two things: first, they had a cascode pre-amplifier in the camera pickup which gave a very high signal to noise ratio, and secondly, they used 35 mm. high quality film in order to show the best possible results. Theirs was purely in the experimental stage of development and here again, there was no provision for the insertion of 2 x 2 or 3 x 4 cards and each separate film projector would require one pickup camera. In this system, the film was projected directly into the Vidicon camera and required either pulsed light or 3-2 pull-down projector.

General Precision Laboratories introduced their version of the Vidicon tube of British manufacture in what was called the Staticon photoconductive tube and claimed a minimum resolution of 600 lines. Very acceptable results were obtained using a 3-2 pulldown projector shooting directly into the camera pickup unit. As a film pickup unit, GPL provides a camera pedestal and a very high quality monitor and control unit. As is the fashion on their larger studio camera units, even a unit this small (approximately 8"x10"x3") had a servo controlled focusing device. Here again, there was no multiplexing method for switching from one projector to another and no method included for the insertion of slides.

Federal Telecommunications Laboratories were on hand with their newly developed Capehart Farnsworth Photocon tube. One distinct advantage in the use of this tube is the fact that the ordinary low cost projector could be used, i.e., it is unnecessary to have a special pulsed light or 3-2 pulldown projector. This unit is higher in cost than the others mentioned before, and compares favorably in picture quality to the other photoconductive tubes demonstrated. Federal Telecommunications Laboratories had a multiplexing system for two

16 mm. projectors to be used in conjunction with the Photocon. They obtained card insert projection by the use of a separate 2 x 2 system employing two flying spot scanners with the appropriate electrical switching allowing lap dissolves and other special effects such as keyed montages and wipes done manually with the outputs of their 2 x 2 flying spot scanner.

One other small tube film pickup device was demonstrated by Standard Electronics. This company would not reveal the type of pickup tube used in their camera, but it was guessed to be a Phillips tube or some similar development. Standard Electronics method of pickup was similar to Dage Electronics in that they used their studio camera to pick up film projected on a rear screen shadow box by an RCA projector or any like machine. Also demonstrated was a mirror multiplexing device with a 2 x 2 projector shooting over the multiplexer onto the rear screen shadow box.

One advantage of all photoconductive picture pickup devices is that they require no edge or backlight on the tube and very little or no shading voltages. The resolution was of a high degree but not up to that of an Iconoscope chain, except on those systems using 35 mm. film. However, on the whole, all were quite acceptable for broadcast quality.

The most widely demonstrated film chain was the continuous motion, flying spot type by DuMont and Philco.

Philco exhibited a 35 mm. and a 16 mm. The reproduction on the 35 mm. was excellent. It used a flying spot light source traveling through a 24 sided rotating prism (1 RPM) geared to the film sprockets and into a photo-multiplier pickup unit. At a nominal cost, this unit could be converted to color by the addition of pickup heads and this was also demonstrated with pleasing results. There was no multiplexer setup demonstrated, which would infer that a separate flying spot would have to be used for each film source. However, this equipment could be used in conjunction with a high quality flying spot card scanner and electrical switching for integration of card and still pictures into the picture system.

Also shown was a 16 mm. continuous motion flying spot scanner still in the extreme developmental stage. It gave a poor picture output due to the stage of development. However, the 35 mm. film scanner gave a black and white picture virtually noise-free and comparable to live studio material. The 35 mm. chain contained a gamma correction amplifier and a film shrinkage control to assist the operator to obtain as near perfect registration from frame to frame as possible.

DuMont was far ahead in this field with a complete two projector chain with multiplexer system for using either projector alone or both simultaneously. Contained also, was a mirror changeover device (manually operated) for the projection of 4 x 5 opaque cards. All video facilities had gamma correction and reproduction of gray scale, as well as resolution, was good. Reproduction of opaque cards seemed to be virtually noise-free as did most of the film (16 mm.). The projectors functioned similar to Philco in that the light from the flying spot traveled through a revolving prism, through the film and into a photo-multiplier pickup tube. Vertical registration from frame to frame was obtained through the use of a manually controlled film shrinkage compensator. Not shown, but also available, was a 2 x 2 transparency attachment. Both flying spot film scanners appeared easy to operate. However, the DuMont unit was more fully developed and provided a flexibility that would be advantageous for economical

operation personnel wise. The DuMont flying spot film scanner appeared ready for the commercial market mechanically as well as electrically and would require only some type of video switching system to completely integrate it into station operation as a relatively noise-free, high resolution picture source.

The latest types of iconoscope film chains were demonstrated by General Electric and RCA.

General Electric's iconoscope chain had several new features over their old film chain. They use the W.E.A.-417 low noise pre-amplifier, focused edge-lights, beam current projectors. Also a 35 mm. strip film projector, a 2 x 2 Selectoslide projector and a 3 x 4 PF-4-A slide projector providing lap dissolves, superpositions, 2 x 2 or 3 1/4 x 4 slides, roll-through script carriage and time, news tape carriage. This unit has been re-designed with only one lens for ease in positioning. The multiplexing arrangements allow for the use of a 3 x 4, 2 x 2, and one or two 16 mm. projectors. The re-designed Synchro-light projector enclosed the movement and is more quiet than their old projectors. Any one frame of film may be stopped and viewed without burning the film and still provide for an almost instant start. These projectors may be "slave" phased to a remote signal to allow the smooth insertion of film into a remote or network program. The light source is a Synchrolight flashtube FT-231 which discharges during vertical retrace and provides a cold light output.

RCA's TK-20-D Iconoscope chain contains a cascode pre-amplifier for low noise output, high intensity edgelight projector to cut down on edge flare and a beam current metering device that allows the operator to set up the same conditions from day to day. Very little riding of the shading controls is necessary. The standard RCA mirror multiplexing system was used with two 16 mm. projectors and an automatic 2 x 2 quick change slide projector. This 2 x 2 projector is the new Gray Telojector which provides for an uninterrupted sequence of twelve slides with a push button automatic lap from one slide to the next. RCA's new professional 16 mm. instantaneous starting projector was used with this unit. This projector has a 3-2 intermittent sprocket pulldown, automatic projection lamp change, still frame projection without burning film, and will accommodate 4,000 foot reels of film. It has a motor which gets the sound drum up to speed quickly and then is removed from the circuit, thus minimizing wows on quick starts. RCA's Iconoscope chain gave good low noise reproduction with little edge flare.

Projectors

A new inovation introduced by the Gray Research Co., is the Telojector. This is a dual lens 2 x 2 slide projector holding 12 slides on two rotating plates. The unit contains two projection lamps which are extinguished alternately to allow for lapping between successive slides. This feature used in conjunction with a special remote control box allows the operator to lap from one slide to the next an any desired rate.

The Selecto-slide Junior was used with General Electric's film chain. This projector holds sixteen 2 x 2 glass slides on a revolving drum. The slides could be advanced automatically from a remote position. However, the machine operates with a one second dark cycle between slide changes. In the case of fast slide projections it is recommended that two of these units be multiplexed in the system.

International News Service had on display the relatively new Projectall Super 300. This has, in one cabinet, two 35 mm. slide projectors, two 3 x 4 opaque projectors and the necessary multiplexing devices to integrate the above with two 16 mm. film projectors into one iconoscope chain. The entire system allows the operator to fade, lap dissolve, super impose, wipe between the various services, run news tape, roll down, project electric clock and models from a remote control panel. All slides can be magazine loaded and are automatically ejected after being used.

Only one manufacturer, the Trans-Lux Lighting Company, demonstrated the rear screen projector. This projector contains an air cooled 5,000 watt projection bulb that may be varied in intensity to match studio lighting conditions or be completely faded in and out. Either still slides or slightly moving background slides can be projected. Ample intensity is provided to fill screen sizes larger than 9' x 14'.

Video Recorders

Only one video recorder was demonstrated at the NARTB convention. This was the new DuMont television recorder. It was very compact and uses an Eastman 16 mm. film camera for recording either single system or double system. Its total cost was 25% lower than those now readily available on the market.

The DuMont TV recorder incorporated facilities to switch to any of five incoming lines, an oscillographic representation of the beam current of the kinescope to aid the operator in setting the proper input levels and to check camera balance. It contained a gamma amplifier to correct for the transfer characteristics of the kinescope tube and the video amplifier section. Either direct positive or master negative recordings can be made on this machine.

The conversion from 30 frame (TV) to 24 frame (film) is brought about mechanically in the film camera thus leaving an uninterrupted picture presented on the face of the kinescope tube. The newly designed high intensity, short decay time tube is supplied with a regulated high voltage supply and is said to give superior recording on either positive or negative film stock. There is a neutral density face plate employed to increase the fine detail contrast by minimizing halation. A circuit is employed to vary the focus coil current over the raster thus maintaining edge focus. A comprehensive metering and indicator panel is included to allow the reading of all critical voltages and to indicate film breaks, buckles and footage. This unit looked to be more simple in construction than GPL.

General Precision Laboratories had on hand literature on their TV recorder with which the author is familiar. As contrasted with either DuMont (or RCA, which would supply but do not stock TV recorders), the GPL recorder has a larger tube than either, with approximately the same phosphor. This allows a higher degree of definition on film without the disadvantage of seeing the phosphor grain on the final product.

It also has a regulated high voltage supply and a beam current meter which will assist in checking camera balance. Unlike DuMont, GPL obtains their conversion from 30 frames (TV) to 24 frames (film) with the aid of an electronic shutter which provides a blanking signal to the picture tube at the proper time for film pulldown.

GPL uses a Maurer variable density single system sound recorder which contains a removable mask enabling the best possible compromise to be obtained on the single system sound.

Included also is a Videogam amplifier for the correction of tube phosphor transfer characteristics to give the correct rendition of gray scale on the exposed film.

The use of an electronic shutter necessitates a larger space than DuMont or RCA recorders. Also it makes it somewhat more difficult to judge picture on the face of the picture tube.

Magnetic Video Recorder Report

Several members of the NAEB Engineering Committee accompanied Mr. A. H. Hungerford, JCET Consultant, on a visit to the Bing Crosby Enterprises Laboratory in order to secure information regarding video tape recording. The group met with Mr. Mullen, Mr. Johnson and others at the Laboratory and a discussion ensued concerning their progress and development.

The Laboratory was unable to provide a demonstration of equipment in operation since it was in the process of undergoing change in design. However, it was possible to examine the equipment and to observe its mechanical operation. The tape puller consists of a specially developed mechanism resembling an Ampex Model 200 recorder with a specially developed drive unit. Standard one inch 3M type 111A tape is used at a speed of 100 inches per second. A special twelve section head is used to magnetize separate tracks on the wide tape. This same head is used for playback. Laboratory engineers claim a bandwidth of 3.39 megacycles is obtainable in the overall process. While they admit that the bandwidth is low, they maintain that the apparatus provides a psychological resolution greater than that which might be expected. (This is perhaps partly due to the 100% utilization factor obtained in recording vertical definition). They tended to indicate that such bandwidth was not sufficiently great to permit satisfactory use of the system in recording masters for further film duplicating. They felt, however, that it was adequate for use where duplicating was not a factor.

The general layout and amount of auxiliary equipment indicates that it is more than likely packagable into a size comparable with that of standard kinescope recorders. In fact, they are at the present time in the process of scaling down their various electronic units to sizes considerably smaller than that of the original developmental units. They propose that playback units could be entirely self contained such that the entire machine would be no larger than a console type tape recorder.

Mr. Hungerford outlined the problems facing educational television stations as related to the procurement of video recording apparatus for use in a coordinated library. Laboratory personnel were questioned regarding the advisability of educators investing in standard kinescope recorders as related to the availability of the magnetic medium. In answer to this, the Laboratory seemed hesitant to advise that educators dependent upon large scale interchange of recorded material plan their present equipment on the basis of tape. As they had pointed out, present design could not guarantee quality adequate for film dubbing. Hence any organized plan for program distribution would have to be based on the availability of a sufficient number of machines for all participating stations. Since production schedules for such machines have not been determined, Laboratory representatives could give no encouragement for delaying

any large scale film program plan which had immediate use for a video recording medium. Notwithstanding the fact that video magnetic recording is not immediately available to the broadcasting and film industry, it seems safe to go along with Mr. Mullen's prediction that use of the medium will grow rapidly once it is fully developed and made available to the industry.

TELEVISION SWITCHING PANELS

A wide variety of video switching panels was on display at the NARTB convention. Several manufacturers featured simple, compactly-arranged panels, providing the minimum requirements for television station programming from network and film sources. Many standard panels with manual control of lap dissolve and super-positions were demonstrated. Two more elaborate units, featuring electronic control of laps and fades, attracted considerable attention. For broadcasters with many simultaneous switching operations, several manufacturers displayed pre-set switching panels with some including both audio and video control. The following is a brief description of currently featured television switching panels, starting with the most basic units and continuing with other units in order of complexity.

Basic Type Panels

The simpler panels were included as part of the so-called "one man" or "basic buy" packages. The GE type TC 39-A Program Switching Panel provides a means of selecting any one of six inputs, such as film, studio, monoscope, remote or network, for transmission to the transmitter or master control. A lock-in feature enables an operator to simultaneously switch audio and video signals by means of the video push buttons. A "clip-fade" control can be used to reduce the video signal in the following video amplifier to black, at which time an instantaneous switch may be made to a new signal and then the new signal is faded up. An additional row of buttons will select any input channel or the video output for monitoring. Start-Show-Stop control is provided for two projectors. These features represent a minimum and, as such, were included in practically all control panels on display.

The RCA Video Control Panel, which is part of the TC-4A Audio Video Console, is also typical of this basic type panel. However, the projector operational controls are mounted on a separate horizontal panel and the monitor selector switches are usually added as part of a master monitor.

Manually Operated Panels

Lap dissolves and superpositions were provided in several panels by the addition of two rows of input selector buttons and a pair of fading controls. The output, after mixing, is generally fed through an additional button provided in the row of direct output selectors.

The General Precision Laboratories Video Switcher is typical. However, this particular switcher is part of a portable unit. It normally swings out of its case for operation. It may be completely removed for table mounting with the addition of two extension cables. GPL is now planning a new panel specifically designed for studio use.

The GE Type TC-41-A Studio Relay Switching Panel controls fades, lap dissolves and superpositions manually. However, all incoming lines are terminated in a rack and switching is controlled remotely by relay. Special low capacity

relays are employed to provide wide bandwidth. Provision is made for twelve non-composite plus three composite inputs. Superpositions can be previewed before going "on air."

The DuMont Type 5262-A nine-channel switching unit produces a variety of effects by means of a single operating control. This fading control varies the bias of the two input tubes of the following mixing amplifier, permitting a smooth transition from one channel to another. A separate control sets the bias crossover voltage of these tubes so that any degree of fading, lapping, or superpositioning of the two signals may be accomplished. Not only can the variety of special effects produced be set up easily, but they can also be previewed before being put on the air if a special monitor is provided. Facilities are available in the mixing amplifier for inserting blanking for special effects, such as wipes, montages, etc. Each input channel is provided with a toggle switch to receive either a composite or a video signal without sync.

Electronically Controlled Panels

General Electric displayed both four and nine channel mixing panels with electronic control of laps and fades. Five push buttons provide a selection of either fast or slow control of both effects, as well as instantaneous switching. Manual control is also included to provide a wealth of special effects. One pair of controls makes possible fades, lap dissolves, superpositioning, horizontal wipe, and four types of corner insertions. A set of push buttons is used to preset the function desired.

Pre-set Panels

Three mixing panels arranged in a manner similar to conventional audio pre-set mixing controls were on display. These panels feature the convenience of single control operation at change-over time, thus reducing possible operating errors. Control may also be conveniently extended to remote points. A GE panel uses two vertically arranged rows of selectors for both audio and video inputs. A master operate switch simultaneously interchanges the monitor and transmitter outgoing lines. "On air" indicators, an audio volume indicator, and a fader control are included.

General Communications, Inc., displayed a six channel audio video switching panel that could be furnished with one or two outputs and with or without a monitor output. Each output line is provided with both an audio and a video selector switch to pre-set a program. Control can be extended to any one of two additional locations. Four rows of six indicator lights display operating status for each output channel.

A panel manufactured by the Standard Electronics Corp., provides interchange of video transmitter and monitor output signals with the aid of a cross-bar type switch. All incoming lines are terminated in a rack and are bridged with a pair of cathode followers. Two rows of cathode followers are thus formed with all input signals appearing in both rows. Switching is accomplished by throwing the cross-bar type switch, which then applies plate voltage to the channel previously pre-set by depressing one of the row of selector buttons.

General

The panels listed above may also be classified with respect to the type of

switching used. Direct channel switching involves the extension of coxial lines to the switching point and can become involved if many input channels are to be included. For local switching with short direct runs of the video cables, this method is probably as compact as any other. Switch timing is not adjustable and remote control is impossible. Remote relay switching permits all video coaxial connections to be made in a rack with only DC control wires connected to the control panel. Control can thus be extended to other locations such as a remote studio console with relative ease. The addition of a jack bay in the relay rack will provide additional flexibility in the selection of input channels. A third type substitutes cathode followers for the relays in a remote control system.

A number of features have been included by most manufacturers. Lucite push buttons that are lighted internally when pushed provide a visual check. Instantaneous switching is accomplished during the vertical blanking period for smooth transfer.

Special Effects

A number of special effects were included as special features of television switching panels. These were described above. In addition, RCA displayed a special effects panel that would delight any program director. Any conceivable type of wipe or insertion that can be constructed of straight lines seems to be available on this panel. For example, a diamond shape insertion could be established in the center of the picture and enlarged or reduced in size at will. A "joy stick" type of control provides a single handle to control both horizontal and vertical functions. Associated electronic control panels and necessary power supplies require a full standard size rack.

AUDIO EQUIPMENT

The special requirements of television broadcasters has brought about the redesign of many audio units. These components, as well as other audio equipment displayed for the first time at the NARTB convention, are described briefly below.

Microphones and Stands

Microphones such as the RCA "Starmaker" and the Altec 21B, though small in size, have been designed with the aid of various acoustical devices to provide superlative performance. Performers are no longer hidden behind or required to play to the "live" side of such microphones.

Receptacle type floor and table stands are now available for such microphones as the RCA "Starmaker", permitting both carry-around and stationary applications.

Many telecasters, especially those working in small studios, have felt a need for a microphone boom with the light construction of a radio boom and the control features of the massive perambulators. The new Century 3555 Mike Boom combines maximum rigidity with minimum weight, and folds compactly for storage or transportation. Its boom telescopes from seven feet to eighteen feet with remote control of the microphone at all positions. A rear handwheel rotates the microphone 360 degrees in a self-leveling, vibration damping mount.

Audio Consoles

New audio console designs included many features to meet the special needs of telecasters. Small component parts and miniature type tubes allow a large number of inputs. Plug-in type amplifiers permit tailoring a console to meet the particular needs of a given station and, at the same time, leave room for future expansion. High gain and low distortion amplifiers permit more distant microphone placement. Sub-masters provide common control over a group of microphones while special interlocking provisions prevent possible feedback. Cabinet designs have been changed to match other television equipment.

The GE Type BC-11A Console includes nine mixers and seven pre-amplifiers which will provide virtually any combination needed to program live, film and remote shows. A superimpose system allows turntables to be fed to the studio and/or the program mixer. It may also be used as a sub-master control to set level on any number and combination of inputs. This console may be easily adapted to dual channel output.

The Altec 250A Speech Input Console has two main program channels capable of operation on separate channels without interference. In addition, it has an independent monitoring channel for loudspeaker listening to programs being transmitted through either of the two main channels or direct from incoming lines or cue circuits. The equipment has a nine channel, low impedance parallel mixer. Seven of these mixer volume controls are associated with seven pre-amplifiers provided in the equipment for operation from twelve connected microphones. The other two mixers are associated with higher level inputs such as incoming program lines. A patch panel is provided. All knobs and keys are color coded for ease of recognition.

The RCA BC-2B Studio Consolette featured a high fidelity speech input system for two studios, an announce booth, two turntables, five remotes and network. The consolette has eight mixer positions and four pre-amplifiers with provision for the addition of two more. RCA also manufactures matching consoles planned for use adjacent to the BC-2B Studio Consolette. One unit provided additional inputs. Another unit, the BCS-3A, makes it possible to feed turntables to a studio loudspeaker for background purposes and to accommodate the talkback and cue requirements of studio, projection room and order wire circuits.

Continuous Tape Reproduction

The Ampex Electric Corp. demonstrated its new model 450 continuous tape reproducer. Two of these players could be employed to provide up to eight hours of broadcast program without a standby operator or announcer. Program content or music would be on one machine with the second playing local announcements and station breaks. A recorded, but sub-audible, twenty five cycle tone is used to stop the first machine after completion of a program or musical selection and, at the same time, start the second machine containing local announcements. Then a similar sub-audible tone on the second machine would restart the regular program after the announcement. A clock set at pre-determined intervals could be used along with a third machine to insert statopm breals. Double track recording is used at aatape speed of 3 3/4" per second. Fourteen-inch reels are required for an eight-hour playing time. The frequency response is plus or minus two DB from 50 to 7,500 cycles.

ANTENNAS AND TOWERS

There were practically no new designs in antennas shown at this exhibit, The major emphasis appeared to be on improved adjustments for eliminating nulls with higher gain antennas and beam tilting for selective coverage. For VHF use, the well known "turnstile" variety is used almost exclusively with the triangular loop (Federal) and "Supergain" (RCA) in some specialized cases. UHF antennas shown were of the helical (GE) and slot (Workshop Associates and RCA) types. Both are mounted in much the same manner and will provide power gains of much the same order.

Towers were of the usual design with the Wincharger Co., announcing a new 500 foot, low cost, steel, guyed tower of uniform cross section designed to support at least a six bay, lower VHF band super turnstile antenna. This tower may be obtained either galvanized or non-galvanized. Loading data was not available but will be published soon.

MICROWAVE RELAYS

Several microwave relay links were displayed with some unique features. Perhaps the most noteworthy was the attempt to transmit both audio and video information on the same link. The demonstrations were excellent.

Ratheon Mfg., Co., demonstrated two units, the Microlink and the Megnalink. The former was designed for portable use with a power output off 0.1 watt. The RF units are directly attached to the parabolic dishes with up to 500 feet of camera cable used between RF units and control units in both receivers and transmitters. This system provides multiplex wide band video and high quality audio transmission and reception and is very compact. The Magnalink is a fixed rack or cabinet installation providing a transmitted power of 50 watts and designed for long distance relay work. Parabolic dish radiators are remotely mounted. Audio channel sub-carrier equipment is available for simultaneous audio relaying.

The DuMont Laboratories displayed a Motorola microwave television relay unit providing a video signal, a program signal on a sub-carrier channel and a two way service (voice) on a sub-carrier channel, all frequency multiplexed on a single RF carrier and with an output of 100 mw. Both transmitting and receiving units are of a fixed nature with weather-proof construction and with the parabolic dish radiator mounted on the equipment cabinet. Although the entire unit may be mounted on an elevated structure, it is quite heavy and it is recommended that ground mounting be used with an elevated passive reflector.

Federal Telecommunication Laboratories announced a microwave relay link of fixed mounting design, The parabolic dish radiator is separately mounted and connected to the transmitter unit by coaxial cable. Recommendations include a short transmission line with the antenna ground mounted and an elevated passive reflector. The power output of this transmitter is 5 watts. Although the unit provides only one channel for video information, a sound channel may be added which provides facilities for the transmission of high fidelity sound, along with video, over the one unit.

The Philco Corporation displayed a rather complete line of microwave relay equipment. Basically the same individual units were shown rack mounted for fixed installations and also mounted in carrying cases

for portable use. The latter required two cases plus parabolic dish antenna for receiving and three cases plus antenna for transmitting. Each case weighs approximately 65 pounds. Transmitter output power is 1 watt and antenna is remotely fed by coaxial cable or wave guide although it is recommended that the antenna be ground mounted and an elevated passive reflector used in order to reduce line or wave guide losses. This manufacturer prefers to use a separate system for the transmission of video information and will supply voice channel frequency-division multiplex equipment to provide a multiplicity of audio channels along with telemetering and control channels.

ACCESSORY ITEMS

Studio Lighting

Two manufacturers, Century and Kliegl Bros., exhibited equipment at this show. No new types of lighting were shown, the improvements being in redesign for convenience and decrease of weight. Some improvement was also evident in adjustable supports and positioners. New equipment in this field was mainly confined to remote lighting control with both manufacturers showing improved control systems both manual and electronic. In the latter system a number of different arrangements could be preset which would allow the operator to immediately light the desired preset combination with one switch. It is expected that this convenience would assure more rapid and accurate lighting of changing sets. Some devices for remote control of light positioning were shown which might be desirable for larger units and those not easily accessible.

Camera Dollys

Three types of pedestal dollys were shown. One type, used for some time, elevates or lowers the camera by rotating a wheel and another uses a counterbalancing lead weight which allows elevating or lowering by pushing up or down on the camera unit. The third, displayed for the first time by the DuMont Company, operates pneumatically resulting in effortless operation of camera positioning. Thus the operator merely "encourages" the camera to go up or down and compressed air does practically all the work. A closed air system and reservoir is located at the base of the piston on which the camera is mounted.

Television Distribution Transmitters

Two such units were offered; one by RCA called the Monitran and one by DuMont called the Dumitter. In operation the video and audio information from a television studio installation is inserted into the unit and the output provides an RF signal which may be tuned to any of the VHF channels. By means of a coaxial cable or, in some cases, even a simple twin lead, one or more ordinary television receivers may be connected and serve as monitors for studio or remote use. The units are non-radiating and their use eliminates many costly distribution amplifiers and special monitors, where extremely high quality is not required.

Teleprompter

These units were demonstrated throughout the show and drew considerable attention. They are available in several sizes and the basic package includes

two viewers, two camera mounts, floor stand and mounts, two junction boxes, one power unit, change kit, electric typewriter, cable and a supply of paper. A number of viewers may be used, operating in synchronism and controlled from one source. By means of a hand held device the operator has complete control of starting and stopping, rate of display, and forward and reverse. This system has proven valuable especially for individual speakers and is said to reduce rehearsal time in many television productions. It is not sold outright but is leased by the Teleprompter Corp., 270 Park Ave., New York.

Transmitter Remote Control Equipment

Although this epuipment may not be used in connection with television transmitters, new FCC regulations allow its use in some broadcast installations. Two manufacturers, Continental Electronics Mfg., Co., and the Rust Industrial Co., displayed equipment for remote control of transmitters. Such remote control equipment provides all the necessary transmitter control and monitoring functions required. Two telephone lines (4 conductors) are necessary between the transmitter and control position.

Color Television

Only one color television unit was demonstrated and this by the Philco Corporation. The new Philco continuous motion, flying spot scanner with 35 mm. color film was used with an NTSC compatible system. Excellent reproduction was obtained on monochrome receivers. Only one color monitor was available which utilized three kinescopes with dichroic mirrors and most observers reported good color reproduction. The film chain used is described elsewhere and was perhaps the most interesting new development although only a laboratory model was available and production is indefinite. The continuous motion flying spot film scanner may be used for monochrome and with a minimum of added equipment, may be converted for color. It may be applied to all color systems and is said to have a resolution of better than 500 lines with signal to noise ratio of better than 35 DB. No color cameras or other studio equipment were displayed and no prices were available.

NAEB Engineering Committee

Robert C. Higgy
Berten A. Holmberg
Robert H. Johnston
Keith Ketcham
Edward Kratt
Carl H. Menzer, Chairman

Section II

Condensations of the Technical Papers

Zoom Lenses in Television by Dr. Frank G. Back

A new Studio Zoomar lens for television cameras was described by Dr. Back, secretary, Television Zoomar Corporation. This lens combines the advantages of the Standard Zoomar lens with features especially desirable for studio work. The Studio Zoomar has one common rod for zoom control and distance setting. Its zoom range is from 2½" to 7½" and the maximum stop opening is F:2.8. The weight is 6 lbs. and the length one foot so that it does not interfere. The lens may be mounted on any TV camera and is interchangeable between cameras of different design. On cameras with center hole turrets it can be mounted simultaneously with three other lenses so that no camera is tied up by the Studio Zoomar. Optically is compares favorably with standard studio lenses.

Proof of Performance Measurements for Television by Rodney D. Chipp

Since much literature has appeared on this subject in the last few years, Mr. Chipp limited his discussion to two areas which he felt needed additional clarification. These were the visual sideband attenuation characteristics and the transmitter power output measurement.

The side band attenuation characteristics may be measured in at least two ways. The first method utilizes a composite video signal consisting of standard sync and blanking with sinewave modulation at selected discrete frequencies occupying the interval between blanking pulses. The sinewave modulation is generated in a video signal generator and is introduced into a line amplifier or stabilizing amplifier. An oscillograph is connected to the rectified transmitter output and the vertical trace deflection is recorded for each frequency. Suggested frequencies are 100 kc, 500 kc, 1 mc, 1.5 mc, 2 mc, 3 mc, 3.5 mc, and 4 mc. The db differences are plotted on rectangular coordinates. Curves of the ideal as well as the upper and lower limits are published by the FCC and RTMA.

An alternate method for measuring the attenuation characteristics involves the use of sinewave without sync and blanking. During this measurement any transmitter clamping circuits must be disabled and the DC level set manually for mid characteristic operation. With the video input at zero, the RF drive is adjusted to dissipate rated average power in the dummy load. This will be 3kw. for a 5kw. peak power. The RF waveform monitor is then set so that the peaks are at 77.5%. This is the average value of voltage equivalent to the rated peak power output. The bias on the modulated stage is then adjusted to midway between black level and white level. The video signal generator is then used to generate the various frequencies and the rectified output is plotted conventionally.

Transmitter power output is generally measured by means of a dummy load. There are two basis types of dummy loads. The calorimeter type load consists of a ceramic tube having a resistive coating, which is cooled by a flow of water. The flow of water, and its input and output temperatures are recorded.

From these data a simple calculation gives the average power dissipated in the resistor, and multiplication by 1.68 give the peak power. It is important that sufficient time be allowed to permit temperatures to stabilize before using this type of load.

The other type of dummy load consists of a terminating resistor immersed in a tank of oil, which is cooled by water. A portion of the voltage across the resistor is read by a meter, factory calibrated by the calorimetric method to read watts.

The Multiscanner by J. H. Haines, Allen B. DuMont Laboratories

During the last few years much effort has been devoted to research in film pick-up methods for TV. One approach that has evolved is the flying spot scanning method with continuous motion film. The "Multiscanner" is one such device manufactured by DuMont for the pickup of film, opaques, and slides.

This paper described the theory of operation and construction of this revolutionary piece of equipment. Basically the Multiscanner consists of a cathode ray tube, upon which is traced a standard television raster. This raster is unmodulated and of uniform brightness. The raster is projected by lenses through the film medium onto a photo tube. The flying spot is modulated at any instant by the density of the film it passes through. The output of the photo tube is amplified, corrected for gamma, dc inserted, and finally added to sync and blanking to provide the composite video signal.

Several inherent advantages of this system can be pointed out. First of all the instantaneous video output signal is directly proportional to the transmission at any point of the slide or film. Consequently, given a certain density range, a corresponding signal is produced. In other words signal levels are much more stable and need little adjusting since they are not dependent on average scene brightness. Also, spurious electronic shading effects are inherently absent and a stable black level is automatically produced by the retrace blanking.

Another interesting advantage of this system is the fact that from one light source (the raster) several optical paths may be multiplexed into several different pickup units. Thus several outputs can be obtained at the same time. This unit is designed to give two independent outputs from motion picture 16 mm. film plus one opaque slide and one transparent slide output.

Since the motion of the film is continuous as opposed to intermittent, there is much less wear on the film. Sound from the operation of the equipment is also reduced. To stop the motion of the image during scanning, a 24 sided prism is employed. This prism is driven by the mechanism which drives the film.

Television Transmission Test Equipment by Roy Moffett, NBC

Mr. Moffett presented a summary of the various types of transmission test equipment which has now become standard items at NBC. These instruments produce composite television signals waveforms that are suitable for amplitude, linearity, high frequency transient response, and low frequency phase or "streaking" tests on a television system.

The first instrument described was a Frequency Burst Generator. The output signals from this instrument consists of its own line frequency blanking and sync plus bursts of frequencies at discrete intervals. These intervals, for example, may be .5, 1.5, 2.4, 3.5, 3.9, and 4.3 mc. This signal is used to test the amplitude characteristic of transmission equipment. Its advantage over the familiar sweep generator is that the signal more closely resembles the average video signal. Since blanking and sync are present in the output, the clamping amplifiers do not have to be rendered inoperative when using the Burst Generator.

The Step Wedge Generator is used to test the linearity of transmission equipment. The output signal from this instrument consists of blanking and sync and in the interval between blanking pulses occurs ten steps of voltage much like stair steps. The width of the steps is about 5.25 microseconds and the rise time approximately 0.5 microseconds. The highest frequency in the stepped wave is about 1 mc. The steps can also be arranged exponentially to check a "gamma" amplifier and the gamma controls adjusted to obtain linear steps.

The Window Generator produces a signal which when viewed on a monitor looks like a white rectangle upon the center of a black background. Controls are available to set the levels. Black background level is usually set to 10% and the white window at 90%. This signal is very useful in checking phase response and streaking. Any discontinuity or bump in the frequency response will show up as streaks, tilts or waviness in the outline of the window.

The 2.5% Horizontal Marker generator generates sharp pulses at 1.59 microsecond intervals. These pulses are used to measure sync and blanking pulse widths. Thus seven pulses should occur during horizontal blanking, one during the front porch interval, three during sync, and three during the back porch interval.

Video Tape Recording by John T. Mullin, Bing Crosby Enterprises

Mr. Mullin limited his discussion of video tape recording to the basic fundamentals. Many details of this development cannot be released until the design is ready for marketing.

Mechanically the machine looks much the same as an ordinary console type tape recorder. An improved type of drive system moves the one inch wide tape at about 100 inches per second. The recording head records 12 channels onto the standard 111A Scotch Sound Recording tape.

Electrically the composite video signal is first stripped of its sync. The sync is modified somewhat and then recorded on one of the 12 channels. The video signal is modified and recorded onto ten channels. The audio is recorded on the remaining twelfth channel. During the playback the stations' sync generator is slaved to the sync of the recording. The video is assembled back to a composite signal.

Present stage of development records a bandwidth of 3.39 mc. Mr. Mullin claims that this presents very acceptable quality and at least better than that obtained by kinescope recordings. Furthermore, gray scale rendition is very good, in fact, Mr. Mullin pointed out that both resolution and gray scale are designed right into the equipment and therefore does not require the control that the film process does.

For the future of video tape recording, Mr. Mullin made these predictions. It is very likely that future playback models will be entirely self-contained in a console type tape recorder. Very soon a model will be developed that uses one-half inch tape instead of the present one inch, He has very good hopes of having their final model ready for manufacture by the first of next year, although delays could easily cause an extension of that time. Finally, Mr. Mullin said that little doubt exists now that video tape recording is possible and it seems likely that the future will see a complete replacement of the kinescope process.

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